

Study on electromagnetic shielding efficacy of knitting clothing

Abstract. This paper enlarges on some main influence factors of electromagnetic shielding efficacy from the shielding mechanism of electromagnetic radiation while developing and designing electromagnetic shielding knitting fabric. Such as radiation, radiant distance, choice of radiation shielding material and clothes structure etc. According to these factors, it pertinently put forward the emphasis of design and develop preventing electromagnetic radiation knitting clothing.

Streszczenie. W artykule zaprezentowano skuteczność ekranowania elektromagnetycznego materiałów tekstylnych o specjalnej strukturze. Przedstawiono odzież ochronną z takich materiałów. (Skuteczność ekranowania elektromagnetycznego specjalnych materiałów tekstylnych)

Keywords: electromagnetic shielding knitting clothing; electromagnetic shielding efficacy; influence factor

Słowa kluczowe: ekranowanie elektromagnetyczne, tkaniny ekranujące.

Introduction

In modern society, as the electronic products growing, electromagnetic radiation are increasingly complex and would have its impact in the field of living and non-living. As a bio-energy field as the radiation of the space surrounding, it is increasingly affecting the normal life of people and animals, and has imperceptibly side effects to animals and humans. So electromagnetic radiation becomes a fourth major circumstances electromagnetic waves of radiation sources.

1. Electromagnetic shielding mechanism of knitting fabric

Use the electromagnetic radiation clothing for electric and magnetic fields namely the electromagnetic isolation called electromagnetic shielding. Electromagnetic shielding, which is based on the mechanism of reflection wave generated through clothing and wave absorption.

Electromagnetic wave reached the surface, garment produces wave reflection, the main cause is that the electromagnetic wave impedance and clothing characteristic impedance is not equal, both the numerical difference is larger, the wastage is also the greater caused by the reflection.

Electromagnetic waves penetrate clothing absorption loss arising from the electromagnetic waves that are mainly generated in the garment caused by the induced eddy current. Induced eddy current produces a magnetic field to offset the original anti-magnetic interference, while the vortex flow generated in the shield body heat loss, attenuation of electromagnetic waves of electromagnetic energy to play the role of inhibition.

2. The main influence factors of electromagnetic shielding efficacy of knitting fabric

According to the electromagnetic radiation protection mechanism we know that influence factors of garment shielding effectiveness has a lot, but mainly including electromagnetic radiation sources, radial distances, the shielding material, shielding clothing design, the thickness of shielding clothing, shielding layers of clothing and other factors.

2.1. Electromagnetic radiation sources

Electromagnetic radiation sources, different types of electromagnetic radiation generated by different wavelength, the frequency and intensity, damage to human body level is not the same, the same shielding clothing to different emitters of electromagnetic radiation its shielding effect also is different.

According to previous analysis knows of the shielding mechanism of clothing, if electromagnetic radiation sources have the higher frequency and shorter wavelength, it will

generate less reflection and worse shielding effect, on the contrary, the better the shielding effect.

With the development and design to defend electromagnetic radiation clothing, it should be based on different electromagnetic radiation sources and design of different shield efficiency of clothing, as against radiation intensity and frequency higher and wavelength smaller, should consider designing and developing a high efficiency, and conversely, development and design corresponding shielding efficiency of clothing.

2.2. Electromagnetic radiation sources distance

Electromagnetic radiation is electromagnetic wave through the space radiation transmission to reach the garment surface. According to the frequency of electromagnetic radiation, wavelength, the distance between the radiation source and clothing, it can be divided into the far field and near field area. In the far field, all forms of electromagnetic energy is essentially electromagnetic wave transmitted, and this field strength decay much slower than the induction field, and the electromagnetic field strength is relatively small, the performance of the weak field. In the near-field region, electromagnetic field strength is much greater than the far field. Therefore, the electromagnetic protection should focus on the near field. And the near field electromagnetic field strength changes with distance more quickly in this space is large degree of uneven.

For a fixed to a certain intensity of electromagnetic radiation, the near field electromagnetic radiation intensity is higher, should pay particular attention to near field of electromagnetic radiation protection.

In the near field and the environment in near-field worker to be focused on protection, development and design of electromagnetic radiation is mainly used for protective clothing in the near field of work and life safety of personnel, therefore the development and design must be safe and effective shielding performance to reach the security standards.

2.3 Electromagnetic shielding knitting fabrics

2.3.1 Material selection of knitting fabrics

2.3.1.1 Selection of metal fiber

By test research, metal is the most ideal to defend electromagnetic radiant material, so the electromagnetic radiation can be used knitting fabrics mainly by metal silk fiber, namely metal silk fiber and other fibers blended form electromagnetic shielding fabric. In addition, you still can use a variety of metal ion coating adhesion in knitting fabric, formed certain electromagnetic shielding function fabrics and using chemical deposition method in ordinary knitting fabric surface firmly on one layer "plating" conductive metal layer, forming electromagnetic shielding knitting fabric.

2.3.1.2 The metal fibre content and distribution

The amount of metal fibers in fabric play a great impact on the fabric shielding effectiveness, with the exception fabric, the fabric has been tested and the general fabric shielding performance with metal fiber content increases. According to electromagnetic shielding principle of clothing, its main used a metal fibre to the electromagnetic wave reflex and absorption effect. Therefore, the more metal in the fabric fiber content, electromagnetic wave is reflected back and absorb more, this fabric shielding effect is better.

Metal fibre in the fabric with different distribution will also affect the fabric shielding effectiveness, because knitting fabric plus a metal fiber fabric to form a good conductive network can better stop the destruction of their electromagnetic radiation frequency and to achieve the shielding effectiveness. Therefore, the greater the distribution density of the metal fiber containing metal fibers, the better its shielding effectiveness, conversely, the smaller of distribution density containing less metal fibers, the shielding effectiveness will worse.

2.3.2 Organization structure and knitting fabric tightness

The electromagnetic efficiency of different blends of fabric structure and the different tightness is different. With the same fabric of absolute content of metal fibers (per unit area of the fabric contains metal fiber weight), knitting fabric with double knitted fabric shielding is better results than single knit fabric, high pile knitted fabric than rib knit fabric. When the electromagnetic wave through the fabric of the more large holes, it will go to more backward in its shielding properties. When it through the high pile knitted fabric, the electromagnetic wave will go to more backward and absorption.

2.3.3 The thickness of knitting fabrics

According to the analysis, we can conclude that shielded mechanism of electromagnetic wave propagation to different media interface, absorb and reflect happens, transmit and produce energy loss.

This is because electromagnetic waves in two different medium of different characteristic impedance. Also can be seen even in the clothing of electromagnetic wave multiple reflection, reflection is still quite strong. We can see that the thickness of the fabric will affect the fabric shielding electromagnetic radiation, the thickness increasing, the shielding effectiveness will increase. When the electromagnetic wave into clothing, electromagnetic field intensity will deeply exponentially with distance attenuation of law.

2.4. Electromagnetic radiation structure of knitting clothing

Ideal electromagnetic shielding garment is completely closed, so that allowed more than 90 dB shielding effectiveness is not to difficult. But that is not the case, completely shields is not exist, especially for clothing is concerned. First fabric is not a completely shields, it has many pores and aperture, and made many openings garment, holes, seams, etc. so these have to destroy shielding integrity, make the actual electromagnetic shielding clothing effectiveness reduced greatly.

Because the characteristics, so in garment developing the electromagnetic radiation shielding knitting clothing, we not only consider the function of preventing electromagnetic wave of clothing, but also consider wearing comfortable. Because there will be a lot of aperture and holes in this garment, electromagnetic waves will pass those cracks and holes produce radiation. The higher the frequency, the more the radiation, aperture gaps is the serious

Especially when aperture size close to the wavelength, because the wavelength aperture antenna effect, clothing itself may become an effective electromagnetic radiation detectors, thus seriously damaging the clothing of shielding effect.

3. Conclusions

In daily life, electromagnetic radiation everywhere, how to effectively preventing electromagnetic radiation damage to human body, to human body take all manner of protection, research and development has become the focus of preventing electromagnetic radiation products. There are many factors to affect electromagnetism radiation shielding clothing development and design, in addition to the above analysis, considering the factors of the garment style, epidemic, taking comfort, clothing life, clothing prices, etc. Therefore, the development and design of electromagnetic radiation knitting clothing, should be based on the different radiation sources, consider using a different electromagnetic shielding fabric, undertake suitable clothing structure design to minimize the size of the holes and holes area, strengthening the seams between clothing Juncture stitched closely degrees, so that preventing electromagnetic radiation clothing shielding effect to achieve the best. and can meet the special function clothing taking of performance requirements.

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